

frontal sinus, and a somewhat greater development of the forehead. This would indicate that the Boskop man was of the Neanderthal race, but more advanced in intelligence than the type specimen.

The discovery of this skull offers an explanation of the origin of the Palæolithic implements which are scattered in such vast profusion all over South Africa, and should it prove to be of the true Neanderthal race, as I have absolutely no doubt is the case, we then possess evidence that this remotely ancient type of man migrated into South Africa, and if we conclude the stone implements with which the country is strewn are his handiwork, then he must have existed here in large numbers.

Mr. Piet Botha, the owner of the farm on which the skull-cap was found, readily granted permission for me to excavate. I excavated the site of the find in person, and discovered portions of a rib and collar-bone, part of the mandible with a tooth in it; some more fragments of the skull, and a few roughly chipped stone implements. The remains were found at a depth of 6 ft. in alluvial gravel. On application, the South African Royal Society subsequently made a grant to this museum of 100*l.* to carry on further excavations. The result was disappointing, a small portion of a human thigh-bone being the only result of this more extensive excavation.

The skull-cap and other remains are now in the temporary possession of Dr. Peringuéy, of the South African Museum, where a careful and detailed examination is being made, but which cannot be completed until various data and measurements are procured from Europe. The first report will appear in the *Journal of the South African Royal Society*.

F. W. FITZSIMONS.

Port Elizabeth Museum, Port Elizabeth,
June 30.

MR. FITZSIMONS'S letter is the first authentic account published in Europe of the discovery of ancient human remains at Boskop Farm in the Transvaal. There can be no mistake about the importance of the discovery; the remains of Palæolithic man have at last been found in South Africa. As regards the nature or race of the individual thus found there is room for doubt; an examination of the photographs of the skull-cap reveal none of the characteristic features of Neanderthal man; one can exclude that race with some degree of certainty. The individual to whom the skull-cap belonged was apparently of the modern type, with a head of remarkably large dimensions. European and American anthropologists look forward with great interest to the publication of a detailed account of the Boskop discovery.

ARTHUR KEITH.

Surface Tension and Ferment Action.

THE correspondence in *NATURE* of June 17 and July 22 by Dr. Cramer and Drs. E. F. and H. E. Armstrong on the possibility of the enzymic action of invertase being limited by surface tension, has led me to look up the laboratory records of some experiments which I made in 1892 on a cognate subject. I was at that time engaged in studying the formation of starch granules in various parts of the living plant, and the subsequent dissolution of the granules under the action of the cell enzymes.

In the course of this inquiry I came across a curious fact which suggested that the action of the diastatic enzyme is to some extent dependent on physical conditions existing at the limiting surface of the starch granule and its surrounding medium. Briefly stated, this fact is as follows.

If we mix with a dilute cold-water extract of malt a little solid starch of a kind which is readily attacked by diastase, *e.g.* that from buckwheat or barley, a microscopic examination will generally indicate a very appreciable erosion and partial disintegration of the granules within twenty-four hours, the actual time depending on the initial concentration of the enzyme. If a parallel experiment is so arranged that, with all other conditions remaining the same, the starch granules are kept in suspension by the addition of about 3 per cent. of gelatine, then we invariably find that the rate of erosion and dissolution of the starch is very much accelerated. This difference is also found to occur even if the mobile liquid which contains no gelatine is kept in continuous movement by mechanical means.

It appeared to me that very possibly the lowering of the surface tension of the liquid by the gelatine had enabled the large-moleculed diastatic enzyme to penetrate the granule with greater facility, and since the starch granules in plant-cells are suspended in highly colloidal protoplasm we might here have some sort of explanation of their rapid disappearance under the influence of very small amounts of active enzyme.

Reasoning from these facts, I drew the conclusion that in a given mixture of starch and enzyme we ought to find a diminution in the rate of erosion in those parts of the liquid which are in a state of tensile stress.

My first experiments in this direction were made in a flattened thermometer tube with an elliptical bore having a major axis of 0.4 mm. and a minor axis of 0.2 mm. The bore of the tube was charged with the diastatic liquid containing the starch-grains, which could be kept under microscopical observation through the walls of the tube. Under these conditions, the starch granules invariably showed a much higher resistance to erosion than did those of the same liquid contained in a small flask or beaker under similar conditions of temperature. At first sight this experiment gave some support to the idea of surface tension playing a part, but in a variation of it in which I used a thin film of the starch mixture between two inclined glass plates, I could find no difference in the rate of erosion in layers varying in thickness from 0.3 mm. downwards.

I then proceeded to investigate the action when the starch had been deposited in the interstices of porous substances, and in the first place used glass-wool, which was one of the substances employed by Messrs. Beard and Cramer, as described in their recent paper in the *Proceedings of the Royal Society* (vol. lxxxviii., ser. B, p. 575), on surface tension and ferment action. Under these conditions the erosion even of buckwheat starch, which is the most sensitive to action of this kind, *was entirely inhibited*, no matter how long the reaction was allowed to continue. For a short time I was misled by this result, and it was only after I had recognised the distinct alkalinity of the solutions which had been in contact with the glass-wool that I found the *causa causans* was of a chemical and not of a physical nature. Diastase, like invertase, is extremely sensitive to traces of alkali, and can only exercise its maximum effect in a slightly acid medium.

I satisfied myself that this was the true explanation by substituting for the glass-wool in the last experiment other porous substances, such as asbestos, cotton-wool, and filter paper, when the whole of the inhibitive effect disappeared. Thus failed my attempt to link enzymic action with surface tension, and even the original phenomenon with which I started, the apparent enhancing effect of a colloid like gelatine, admits of a different explanation based on the slightly acid reaction of the commercial product. It is now well

known that an amylohydrolytic agent, such as a malt-extract, is increased in activity by the addition of traces of acid sufficient to convert the neutral into the acid phosphates.

I believe that most scientific workers have, like myself, a scrap-heap of failures which may repay a little digging now and then. In the light of the recent discussion in your columns these few potsherds which have been recovered from the overlying débris of years may at the present moment have something more than a mere antiquarian interest.

HORACE T. BROWN.

52 Nevern Square, Kensington, S.W., July 24.

The Cancer Problem and Radio-activity.

PROF. JOLY, in an address published in *NATURE* of June 10, has given some more facts in connection with the theory associating radio-activity with the cause of cancer; and his endeavour to extend the theory so as to connect some of the commodities which predispose the tissues to the disease will be read with interest by those engaged in cancer research. But there are other such commodities which Prof. Joly has not apparently taken into consideration, especially arsenic and manure; and he is not correct when the attributes "sweep's cancer" to mechanical irritation.

The last point was demonstrated at the recent Home Office inquiries on pitch ulceration and cancer, in association with which extensive research has been made at the John Howard McFadden Laboratories. It appears that there are two forms of pitch, the blast-furnace variety produced at a lower temperature mostly from Scottish coal, and the ordinary gas-tar variety made from bituminous coal. Both varieties are similar in consistency, and both cause similar mechanical injury; yet blast-furnace pitch is harmless, whereas gas-tar pitch gives rise to a considerable incidence of warts and sweep's cancer. Coal-dust may cause mechanical injury amounting to laceration; yet it causes no cancer. Soot, being soft and floury, does not mechanically irritate the skin, yet it occasions in sweeps more cases of cancer than in any other trade. Tar and some of the petroleum fractions are liquids, and cannot cause mechanical injury; yet they both are sources of skin epithelioma.

These commodities evidently give rise to the disease owing to the presence of some chemical agent contained in them, for the more they are concentrated the more disease do they cause. Coal causes no cancer; tar, the residue after the first stage of its distillation, causes some cases; pitch, the residue of the distillation of tar, causes such an incidence as to necessitate two official inquiries; and soot, the last residue of the carbonisation of coal, tar, and pitch, causes the most cancer among occupied males. The question is what is the substance that is being concentrated, and how does it act?

The researches which have been made on this subject are based on the fact that many classes of cells can be made to divide in response to auxetics—chemical agents which contain the amidine or amino groupings. This has been shown now with many classes of cells, including human cells; and Cropper and Drew have recently found that amoebæ, when isolated from other living organisms and placed in pure water, will not divide at all without the addition of an auxetic. Auxetics are physiologically set free in a tissue as the result of cell-death caused by injury; and when they are inoculated into certain tissues can be made to give rise to benign tumour formation, both in men and animals. There is another group of substances (including most of the alkaloids, choline, cadaverine,

etc., to some of which Prof. Joly refers) that increase the action of auxetics very considerably. They have been called augmentors.

Since auxetics cause benign cell-proliferation—which is a very favourable condition for the onset of cancer, a large number of the coal-tar commodities and fractions were tested for auxetics by trying watery extracts of them on human cells. The commodities were sent to the laboratory by the authorities distinguished by numerals only; some were known to cause cancer, others were known not to do so; but the workers who made the tests were unaware as to which were which until the tests were complete. In this way it was ascertained that, by the simple test for auxetic or augmentor, those commodities (about 20) which give rise to cancer can be picked out from a large number (about 150) of those which do not.

Hence it is more than probable that the commodities act by virtue of the auxetics or augmentors they contain; the successive fractional distillations of coal, concentrating the auxetic in each stage, causes a higher and higher incidence of cancer, until the ultimate production of soot with the highest incidence of all (chimney-sweep's cancer).

Since then, all the other commodities which cause cancer, such as arsenic, manure, betel nut (a putrid mixture of areca and tobacco), tobacco and its smoke, "khangri" charcoal, some aniline dyes, and petroleum, have been tested, and all contain auxetic or augmentor. On the other hand, the harmless blast-furnace tar and pitch and the hard Scottish coal whence they are derived contain either no auxetic or augmentor or only a trace of the former.

X-rays and radium rays in certain dosage will produce cancer; but they also cause cell-death, even amounting to ulceration, which in its turn sets free auxetics resulting in cell-proliferation, which is prone to become malignant. Atrophy following nerve disease and injury again produces auxetic in a tissue, and these atrophic areas are liable to epithelioma, as admirably described by Lenthal Cheatele.

Much work remains to be done, therefore, before the theory regarding radio-activity can be proved to harmonise with all the facts, which must include an explanation of why it causes the death of the patient and metastasis. I do not wish to question its soundness; on the contrary, an experiment which Dr. Lazarus-Barlow has kindly made in comparing the radio-activity of the auxetic fractions of gas and blast-furnace tars appears to be evidence in its favour. Even if auxetics ultimately prove to be the sole immediate cause of cell-division, some physical force must produce the division activated by the chemical agent when it has arrived within the cell, and it is possible that this force is connected with radio-activity.

In conclusion it may be mentioned that the terms "industrial cancer," "smoker's cancer," "sweep's cancer," "arsenic cancer," etc., namely, the diseases caused by the commodities mentioned, refer in reality only to a predisposition to the disease. The commodities themselves do not actually cause cancer; they merely render the tissues prone to it, which seems to occur in a specific manner. This was clearly shown at the inquiries; the commodities always in the first instance produce cell-proliferation usually in the nature of warty growth; and it is not until an open ulcer has appeared, generally at the base of the wart, that malignancy supervenes. This fact, coupled with the knowledge that augmentors are produced in a proliferative site by the action of bacteria, makes one suspicious that the exciting cause of cancer is probably of bacterial, or, in any case, parasitic origin. The clinical evidence and the experiments that have been made into the causes of cell-proliferation and industrial cancer demonstrate that when we speak of